It is found that the agreement is, on the whole, tolerably good, whence it is inferred that in torsion, the effect of local action dies out more rapidly than in tension or compression. The only case of obvious divergence is with regard to the shear $\widehat{r\phi}$. This shear persists inside, even at sections where no stress of this kind is applied to the outside of the cylinder, but it continually diminishes as we recede from the ends.

In the exact solution, the cross-sections do not remain undistorted, the transverse displacement increasing more rapidly than the radius. The distortion is small at sections where there is no external applied stress, but is very obvious near the ends.

Further, when the applied transverse shear varies discontinuously, as in this case, the other stress becomes infinite at the points of discontinuity. This suggests why it is that abrupt changes in the section of such a cylinder are dangerous. The projecting parts acting upon the inner core will introduce a sudden change in the transverse shear. It has been noticed that propeller shafts usually break at such points.

"The Measurement of Ionic Velocities in Aqueous Solution, and the Existence of Complex Ions." By B. D. STEELE, B.Sc., 1851 Exhibition Scholar (Melbourne). Communicated by Professor RAMSAY, F.R.S. Received May 10,—Read June 6, 1901.

(Abstract.)

The method of measuring ionic volocities described by Masson has been extended in such a manner that, by the present method, the use of gelatin solution and of coloured indicators is not necessary.

An aqueous solution of the salt to be measured is enclosed between two partitions of gelatin which contain the indicator ions in solution, the apparatus being always so arranged that the heavier solution lies underneath the lighter. On the passage of the current the ions of the measured solution move away from the jelly, followed at either end by the indicator ions; the boundary is quite visible in consequence of the difference in refractive index of the two solutions. The velocity of movement of the margins is measured by means of a cathetometer, and the ratio of the margin velocities gives at once the ratio of the ionic velocities.

It is found that, for the production and maintenance of a good refractive margin, a certain definite range of potential fall is required for any given pair of solutions, and this range differs very much for different boundaries—for example, the margin potassium acetate

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following potassium chloride, or K $\frac{ac}{cl}$ is stable with a potential fall of 0·82 volt, whilst for the stability of the $\frac{cd}{cu}$ SO_4 margin, a voltage of 2·54 volts at least is necessary.

The explanation of this is to be looked for, not in the fall of potential in the measured solution, to which the above figures refer, but rather to the change of potential fall on passing from the indicator solution to the latter, and is probably connected in some manner with the Nernst theory of liquid cells.

Certain regularities in the influence of different salts on the melting points of the jellies have been noted, and it seems that this influence is more or less of an additive nature, depending on the nature of the anion and of the cation. Amongst anions the SO_4 ion has the least, and the $\overline{I}$ and $\overline{NO_3}$ ions the greatest, effect in lowering the melting point. Amongst cations, the K ion has a much less influence than the Li or Mg ions: these relations are as yet, however, only qualitative.

The values for the transport number that have been obtained show a remarkable agreement with Masson's figures, as measured in gelatin, for potassium and sodium chlorides. On the other hand, for lithium chloride and magnesium sulphate no such agreement exists. For all the salts a comparison with Hittorf's figures shows only an approximate agreement, being about as good at that shown by a comparison of the figures for the same salt, as measured by different investigators, by the indirect method of Hittorf.

From a knowledge of the specific resistance of the measured solution it is possible to calculate the potential fall in this part of the system, and from this the absolute average velocity U = xu, where x = the coefficient of ionisation, and u the absolute ionic velocity. A very striking agreement holds between the sum of the velocities of anion and cation and the sum as calculated from Kohlrausch's conductivity figures. The velocities of a large number of ions at different concentrations of different salts have been calculated, and the velocity of the hydrogen and hydroxyl ions have been also measured, with the following results:—

	Found.	Calculated.
OH in KOH, 0·5 N	0·001435	0·00145
„ NaOH, 0·2 N	0·00158	0·00152
H in HNO_3, 0·2 N	0·00282 0·00272	0·00280

The ratio of the current, as measured by the galvanometer, to that calculated from the velocity of the margins in the manner indicated by Masson, is found to be equal to unity only for a few salts of the type of potassium chloride; for other salts this ratio has a value in some cases

greater, in others less, than 1. The same irregularity has been previously pointed out by Masson for the gelatin solutions of the sulphates of magnesium and lithium.

The attempt is made to explain this deviation from the requirements of theory, and also the difficulty that Kohlrausch is unable to assign to dyad elements any value for the specific ionic velocity, which is the same when calculated from the measurements of different salts of the same metal, by the assumption, first advanced by Hittorf, that, in concentrated solutions of these salts ionisation takes place in such a manner that there are formed complex ions in addition to simple ones; and the conclusion is drawn that, in all cases where any considerable change in transport number occurs with changes in concentration, complex ions are present to a greater or less extent.

June 13, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

Mr. James Mansergh, Major Ronald Ross, Mr. Oldfield Thomas, Mr. William Watson, and Mr. William C. Dampier Whetham were admitted into the Society.

A List of the Presents received was laid on the table, and thanks ordered for them.

The Bakerian Lecture, "The Nadir of Temperature, and Allied Problems," was delivered by Professor JAMES DEWAR, F.R.S.

BAKERIAN LECTURE.—"The Nadir of Temperature, and Allied Problems. 1. Physical Properties of Liquid and Solid Hydrogen. 2. Separation of Free Hydrogen and other Gases from Air. 3. Electric Resistance Thermometry at the Boiling Point of Hydrogen. 4. Experiments on the Liquefaction of Helium at the Melting Point of Hydrogen. 5. Pyroelectricity, Phosphorescence, &c." By JAMES DEWAR, LL.D., D.Sc., F.R.S., Jacksonian Professor in the University of Cambridge, and Fullerian Professor of Chemistry, Royal Institution, London, &c. Delivered June 13, 1901.

(Abstract.)

Details are given in this paper which have led to the following results:—

The helium thermometer which records 20°·5 absolute as the boiling